Effective Factors in Technology Transfer in the Pharmaceutical Industries of Iran: A Case Study

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The purpose of this research is to recognize and grade the effective factors on technology transfer in Iran's pharmaceutical industries. The study endeavors to present an appropriate model of technology transfer for the industries. The paper has identified and classified effective factors on technology transfer in seven of the major criteria and each of the main criteria covers different sub-criteria where their weight (the main criteria) are determined by the Analytical Hierarchy Process (AHP) model. The study has utilized the experience of other companies in developed and newly industrial countries in the field of technology transfer, for enriching the result of the research.

Keywords: Technology, Technology transfer, Technology transfer process

Introduction

In the present research, to define the technology, we have utilized the technology triangle. Technology triangle contains the following three components:

1. Human resources or people
2. Technical knowledge or know-why and know-how
3. Hardware or physical tools

The angles are related to each other and are reciprocal. Effective application of technology depends firmly on the interactions between the three components, and it is a unique process for every company or country. Technology transfer among different countries and organizations with various levels of the technical knowledge covers limitations and problems for the less developed recipient. Technology transfer is a complex and challenging process which needs a deep and all-out study. In the case of overlooking different aspects of technology transfer; it may lead to weakness of the national technology. Technology transfer process includes some preventive scales, which should be addressed, before selecting technology transfer methods. The factors included are:

- Awareness of fundamental and important factors required in technology transfer process.
- Awareness of failure factors of technology transfer.

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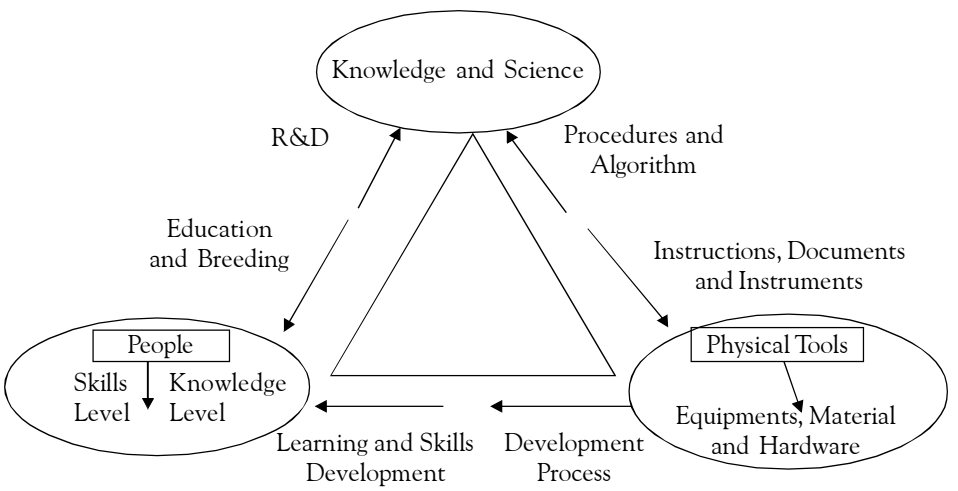
- Effort in acquisition of appropriate technology for achieving appropriate organizational position.
- Consideration of existing and old technologies.

Accordingly, it is stressed that the technology transfers process should import the entire components of the technology triangle. But further technology recipients should consider technology's hardware components. This issue has been one of the main reasons for the failure of technology transfer projects for the majority of technology recipients (Paul, 1995).

Technology and Technology Transfer

Technology is defined differently. Sociologists, Economists, Management Scientists, and other faculties, have their own definitions of technology. Apparently there are professional definitions for this word, but all have common aspects. There are different aspects for technology (Figure 1):

Figure 1: Technology Triangle



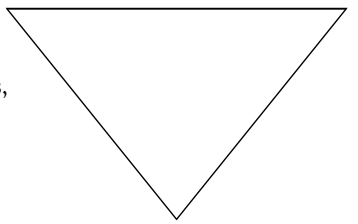
Source: Paul (1995)

Cultural Aspect: It contains goals, values, morals, beliefs, awareness and creativity.

Organizational Aspect: It includes industrial, economical, professional and technical activities, users, customers and commercial unions.

Technical Aspect: Knowledge, skills, techniques, tools, machineries, sources, and production are considered as technology in this paper. Thus technology definition is completely expressed in Figure 2. Technology triangle contains three components:

Figure 2: Different Approaches in Technology Definition



Source: Bateni (2000)

1. Human resources or people
2. Technical knowledge
3. Hardware or equipments

The angles are related to each other and are reciprocal. Effective technology application depends firmly on the interactions between the three components; it is a unique process for every company or country (Bateni, 2000).

Technology Transfer Process

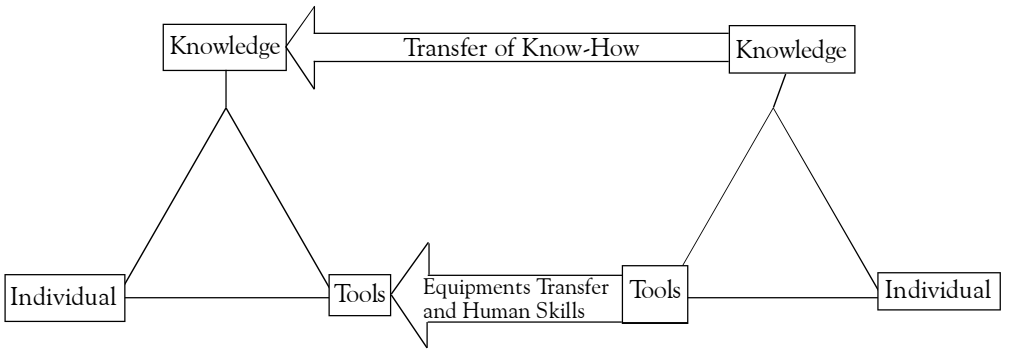
Technology transfer in different countries and organizations with various' levels of technical knowledge covers limitations and problems for the less developed recipient. Technology transfer is a complex and challenging process which needs deep and all out study. In case of overlooking of different aspects of the technology transfer; it may lead to weaknesses of the national technology. Technology transfer process includes some preventive scales, which should be addressed, before selecting the technology transfer method. Included in these factors (Malekifar, 1999) are:

- Awareness of fundamental and important factors required for technology transfer.
- Awareness of failure factors of technology transfer.
- Effort to acquisition of the appropriate technology for achieving organizational appropriate position.
- Consideration of existing and old technologies.

Effective Factors in Technology Transfer

In the technology transfer process, the entire elements of the technology triangle (Figure 3) are to be transferred into organizations and not impose them solely into technology's hardware

Figure 3: Technology Transfer Process



Source: Aghyi (1999)

parts. Thus, they should be fully cognizant of their capabilities and requirements before launching technology transfer. Actually, technological evaluation, requirements and capacities recognition and selection of technology methods are of vital importance in the technology transfer process (Aghyi, 1999). Thus, awareness of effective factors on technology transfer is of great importance for technology recipients. The paper identified and classified effective factors on technology transfer into seven main criteria each of which covers a set of sub-criteria which have been indicated in Table 1.

Table 1: Effective Factors in Technology Transfer

Factors and Main Criteria	Sub-Criteria
Factors relative to technology recipient organization	Long-run strategic planning in technology development; Investment in R&D; and Development of managerial and organizing skills in organizations.
Factors of Absorption and Application	Capability in absorption of importing technology; Establishing relationship between production and research; Training of individual relative to technology; and Interaction with different international centers in technology cooperation areas.
Cultural Factors	Information development in the field of technology transfer methods; Modification of cultural value systems in organizations; and Diffusion of scientific attitude in organizations.
Structural Factors	Localizing importing technology; Employment of entrepreneur managers; and Creation of standards and capabilities in companies.
Infrastructural Factors	Organizational infrastructure; Equipmental infrastructure; Informational infrastructure; and Human infrastructure.
Global Factors	Personnel training in international valid companies; Employment of international specialist in the field of technology; and Creation of appropriate relationship between recipient and sender technology.
Technological Factors	Degree of achieving technology; Degree of transferred technology price; Degree of simplicity and complicity of the technology; and Degree of development and improvement of technology on the basis of internal requirements.

Source: Samli (1985)

Failure Factors in Technology Transfer Process

In general, failure of technology transfer in pharmaceutical companies can be classified into three dimensions: structural, technological and behavioral (Aghyi, 1999). Of course, failure in activities of technological innovation is a natural affair and it does not mean lack of capability and competence in organization and management of technology. It should have a positive and integral behavior with this phenomenon and create a friendly atmosphere in organizations. The players in the scene, local governments, governmental representatives and/or private sectors may interfere in decisions of technology transfer by their control and influence. It is the need of any system which purchases and sets up to adapt to local conditions. The issue of technology adaptation not only focuses on physical performance of equipments; even managerial methods may need some modifications (Malekifar, 1999).

International survey reveals primary resources of technological changes in companies are not solely formal operations in the R & D areas, but done by equipments' adaptation and instructions or procedures with local conditions. As such there is no compatibility between designer's ideas or planners and final users of a technology. In such situations technology recipients will be faced with immense problems. It is said that situations would cause technology failures and transferred technology cannot meet targets and requirements of technology recipients. For successful transfer of technology, recipients should create relationships between their own experiences and cultural fields. Actually, they have to consider organizational dominant values, organizational environment and principles, working behaviors, motivate components, and capacities of their own society or organization. When an organization or country tends to carry out transfer technology and development, they should evaluate behavioral attitudes and human-driven decisions (Ghafaripour, 1999). The decisions may be objective or subjective. Mental hypothesis of individuals in solving technological problems, especially in social areas, is not applicable and cannot be implemented. Mental decisions are sentiments which are affected by factors such as models, theories, working environment and conceptual norms.

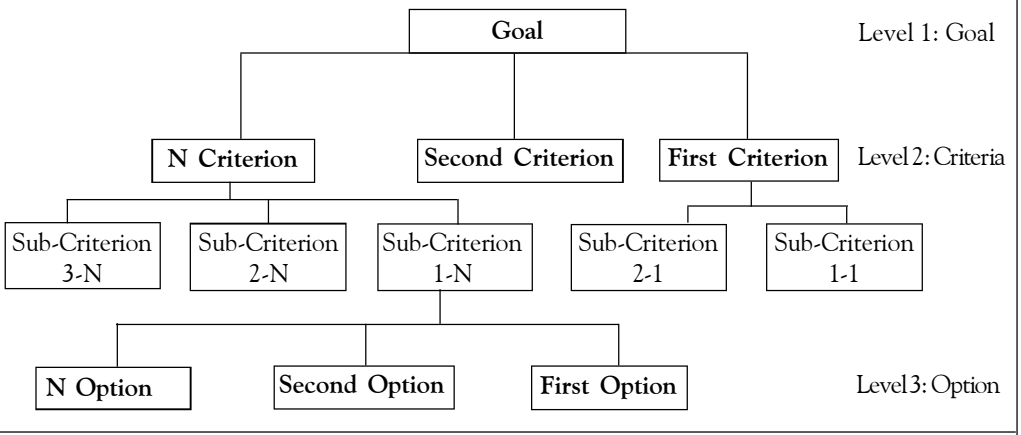
Regarding key role factors—cultural and moral—in technological success transfer, the main issue cannot be regarded in the framework, as a simplified model. Success of technology transfer process in economic and social areas rely on quality of its impact on cultural value systems of the technology recipient. Technology transfer to environments differs and is variable towards the technology holder. It should define appropriate relationship between technology and culture of that society or organization. Besides, which importing technology can have an effect on cultural enrichment should be considered.

Information Analysis by AHP Technique

Regarding theory basis of the Analytical Hierarchy Process (AHP) model, the method on the basis of its own approach, method and hypothesis, a problem will be surveyed. General structure of AHP model is shown in Figure 5. Obtained results of AHP model are considered from two aspects:

1. Priority of entire factors without considering sub-groups.
2. Grading of all factors in framework mentioned sub-groups.

Figure 5: Structure of AHP Model



Source: Yang and Lee (1997)

The Expert Choice software is powerful software which is utilized on the basis of the AHP model for priority of factor and alternatives. The software for solution and grading of the items is applied.

Problem Research

Technology transfer among countries, organizations and specially the pharmaceutical industries with different technical knowledge levels, cover limitations or obstacles for less developed recipients. Accordingly, it needs a model to be able to improve the situation of technology transfer process among receivers and senders of technologies in pharmaceutical companies. It also bears striking results for them, such as taking benefits from resources, time, opportunities, etc. To develop such a model can be expressed by the research problem in the following manners:

- Determination of models, ideas and suggestions for effective transfer of technology among pharmaceutical industries with different technical knowledge levels and evaluating them for defining application capability of importing technology.
- Definition of existing situation of the company's capacity in order to transfer and absorb technology for solving the existing problems.
- Recognition of the existing problems in technology transfer and development of model absorption and transfer of technology for special conditions.

Research Methodology

The purpose of this research is to recognize and grade the effective factors of technology transfer in Iran's pharmaceutical industries. The study endeavors to present an appropriate model of technology transfer for the industries. In gathering information for the research a questionnaire was used as the main instrument for data collection.

The target respondents were top managers and company owners (82 companies). The questionnaire comprised 87 questions. In the survey, the number of respondents were 156. To make sure of receiving enough questionnaires, a total of 170 questionnaires were distributed to all target respondents. A total of 128 questionnaires were returned of which 4 were not usable. Therefore, the number of final questionnaires for analysis were 124. Among the questionnaires, 61 were from top managers and 63 from company owners. In this study, a 5-point Likert type scale, ranging from 1 to 5 (to a very great extent) was applied where 3 represented moderate level.

Research Questionnaire

- What are the effective factors on the success of technology transfer in pharmaceutical companies?
- What is the grading of effective factors on the success of technology transfer in pharmaceutical companies?
- What is an appropriate model of technology transfer for the industries?

Method of Research Implementation

Utilized Methods in the Research

In this paper, first the most important effective factors for the success of technology transfer was recognized and classified. Then, by designing an appropriate questionnaire, attitudes and viewpoints of managers and decisions in areas of technology were received in order to realize the degree of significant and impaction of these factors to successfully transfer technology. Thus, was gained a widespread set of the factors which they should filtrate.

The data analyzed using SPSS package regarding obtained results, the factors which were less significant were deleted. By the AHP technique the factors on the basis of the degree of their significance and impact were ranked. Designed questionnaire included numbers, questions which evaluated different aspects of technology transfer, called for from respondents who expressed their attitudes towards the significance of each of the factors by marking a tick in the appropriate square.

Major Findings

To explore the ranking orders of effective factors on the success of technology transfer, the amount of significance coefficients are a good criteria. Table 2 and Figures 6 and 7 provide a list of the main factors and their ratings. Organizational factor (Table 2) shows a significance coefficient of 0.194. To put it in other words, this factor is most important factor in the success of technology transfer of pharmaceutical companies of Iran. The technology factor has a low rank (0.103). Rank measures of absorption and application, structure, culture, infrastructure and worldwide which are 0.175, 0.157, 0.143, 0.139, and 0.107 respectively, impact the success of technology transfer of Iran's pharmaceutical companies (Table 2 and Figure 7).

Figure 6: Major Criteria of Technology Transfer

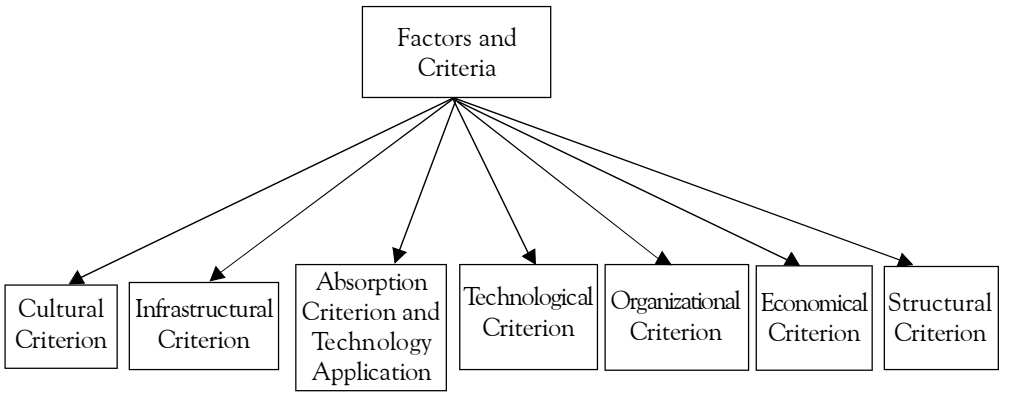


Table 2: Significance Coefficient of Main Factors

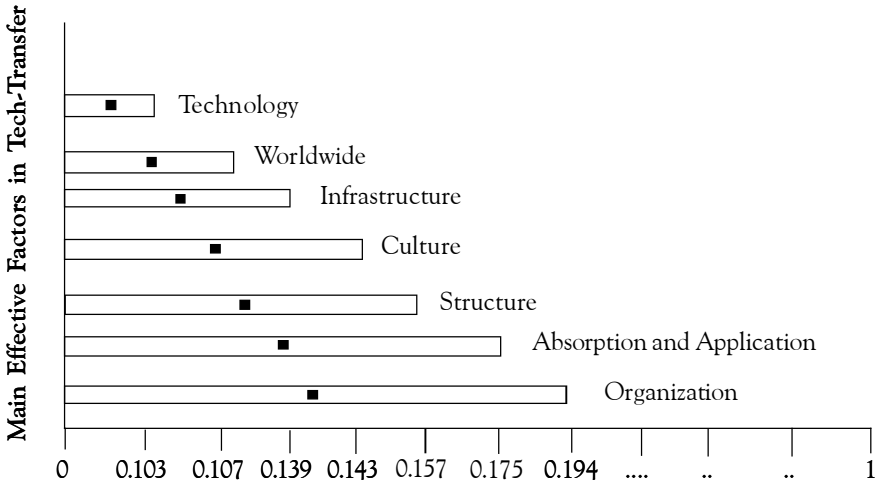
Abbreviation	Definition	Significance Coefficient
Organization	Factors relative to technology recipient	0.194
Absorption and Application	Factors related to absorption and application of technology	0.175
Structure	Structural factors	0.157
Culture	Cultural factors	0.143
Infrastructure	Infrastructural factors	0.139
Worldwide	Global factors	0.107
Technology	Technology selection of pharmaceutical industries	0.103

The research has surveyed different factors and parameters which are effective on technology transfer, and which have been revealed in Figure 6. Each of the main factors covers a number of sub-criteria which are shown in Table 1.

Significant Coefficient of Effective Factors on Technology Transfer

The significant coefficients of effective factors on technology transfer are defined on the basis of their significant degree and impact in technology transfer process. On the basis of obtained results, the factors relative to technology recipient have gained the most significant coefficient. Thus, the factors possess the most impaction in technology transfer process, but it does not mean that other factors are insignificant. After the factor relative to technology receiver, factors relative to absorption, application and selection of technology have the most significant coefficient. In Table 2 these coefficients are shown respectively.

Figure 7: Arrangement of Effective Factors on Success of Tech-Transfer on Significance Coefficient Basis



Appropriate Model of Technology Transfer for Pharmaceutical Industries (Combined Model)

There are various models for technology transfer, but this paper stresses on the Combined Model of technology transfer which is suggested as the most appropriate model of technology transfer for Iran's pharmaceutical industries (Figure 8).

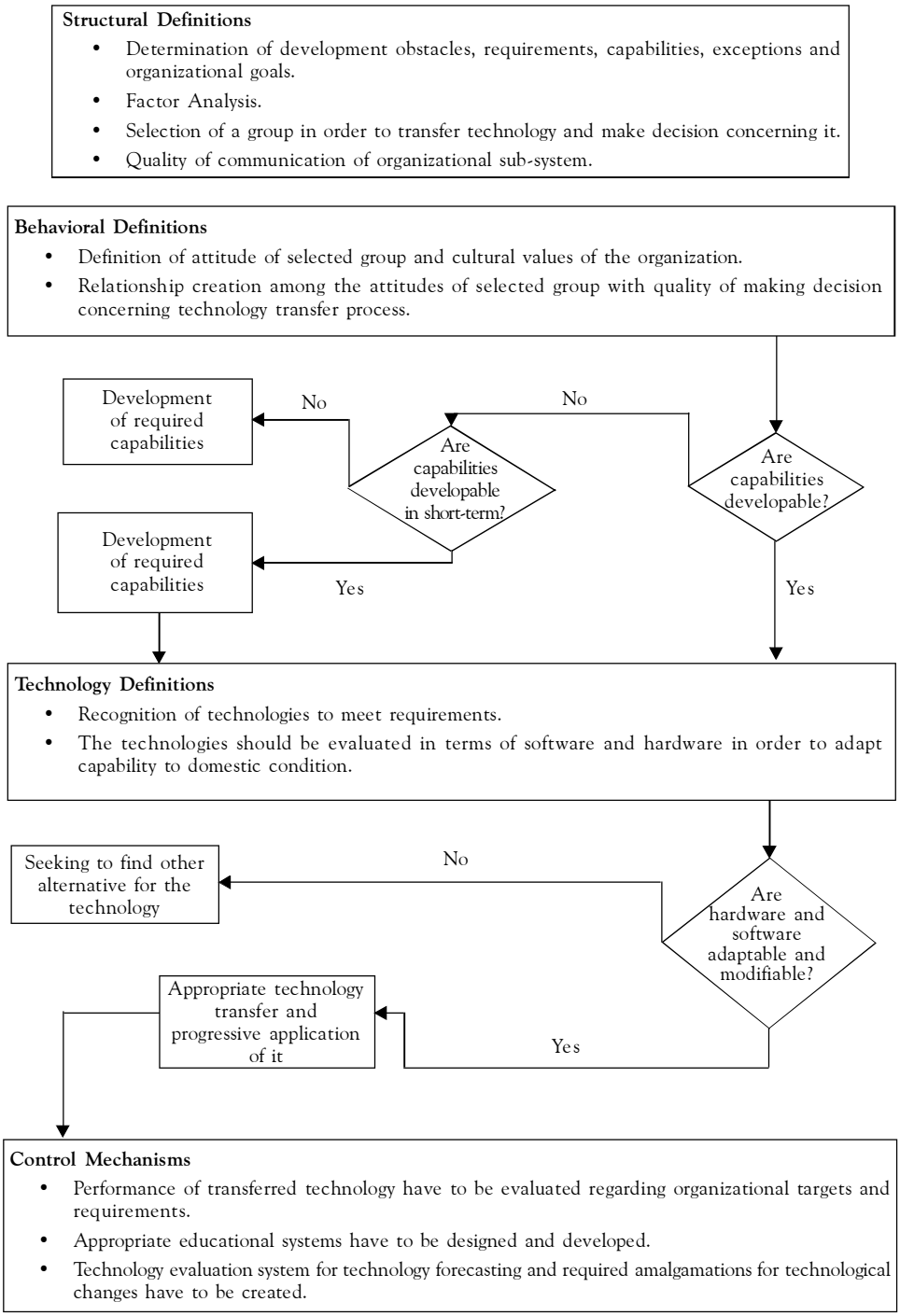
Limitation of the Study

This research was faced with two limitations: (1) Natural limitations, because the tool data was the questionnaire. Applying questionnaire in any research usually will have two errors: Conceptual error and Judgment error; and (2) Unnatural limitation because technology is a strategic resource for the organizations. Therefore, the companies indicated sensitiveness in presenting information (actually they had a conservative behavior). Considering numbers of the companies were public, the researcher dealt with a bureaucracy.

Suggestions for Future Research

Future research could also replicate and extend this research to enrich and enhance these preliminary findings by exploring a larger sample size in different industries. Moreover, additional research could provide practitioners with enhanced methods to implement technology transfer in their different organizational attributes. Additional research is recommended to investigate: "What are the effective factors on the technology transfer projects' success and defeat in pharmaceutical companies and similar companies from the aspect of management of technology?" and, "What are the effective factors on the R&D

Figure 8: Appropriate Model of Technology Transfer for Pharmaceutical Industries (Combined Model)



projects' success and defeat in pharmaceutical companies and similar companies from the aspect of management of technology?"

Conclusion

The results of the data analysis revealed sufficient evidence to components as elements such as structure, organization, absorption and application, culture, worldwide infrastructure, have pivotal role in technology transfer process (Table 2 and Figure 7).

Before an organization launches technology transfer, it should assess and comprehend status quo of these components. The success of technology transfer implementation is mediated by the elements. In addition, the findings suggest which of the elements as organization, structure, absorption and application, culture, infrastructure and technology, respectively have the vital role in technology transfer within pharmaceutical companies.

Successful experiences of the pharmaceutical industries in the developed and newly industrialized countries reveal widespread transfer of the modern and appropriate technologies to the industries, which have enabled the increase in their efficiency and caused their rapid development. Selection of appropriate technology is a vital element in technology transfer effectiveness. If technology transfer is not along correct selection and recognition, there would be no achievement, except waste of investment and environment contamination. To succeed in technology transfer, control on know-how and know-why of importing technology is essential. Accordingly, pharmaceutical companies should be more accurate in the technology transfer process. In general, when technology transfer is profitable, technology recipient can localize importing technology and will also be able to create new technology or improve existing technology. If there is no modification and amalgamation capability, the importing technology will not be to meet local requirements. In such situations, technology transfer cannot contribute to technology recipient but may create other unwanted problems.

The findings of this research could help to management companies, research scholars and practitioners to develop a better understanding of the role of these effective factors in the successful implementation of technology transfer. ■

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